

DESCRIPTION OF A NEW NORTHEASTERN ATLANTIC AEOLID OF THE GENUS *FLABELLINA* (MOLLUSCA, NUDIBRANCHIA)

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ABSTRACT

A new species of aeolid nudibranch of the genus *Flabellina* Voigt, 1834 is described from the Bay of Arcachon (France), in the northeastern Atlantic. This species is cryptic of the aeolid *Piseinotecus gaditanus* Cervera, García and García, 1987. The external appearance is identical to *P. gaditanus*: body color is translucent white, ceratal surface transparent, digestive gland duct bright red and apex translucent white. The cerata arise from peduncles arranged in groups of five to seven, and opaque white spots are scattered all over the cerata surface. The radula is triseriate and the rachidian tooth has a triangular central cusp. The lateral radular teeth are smooth and the jaw masticatory border is denticulated with three rows of denticles. The reproductive system is very similar to that of *P. gaditanus*: the ampulla is large and rounded, the receptaculum is elongated, the prostate is short and relatively thick, and the penis is unarmed. The principal difference between the new species and *P. gaditanus* is that the first former has a triseriate radula, and the latter, a monoseriate radula.

The genus *Piseinotecus* was introduced by Marcus (1955) to include the species *Piseinotecus divae* Marcus, 1955 from São Sebastião (Brazil) within the Aeolidina. This genus is characterized by smooth or slightly annulate rhinophores, cerata in tufts arranged in a horseshoe-shape or in rows, an uniseriate radula with strong median cusp, only one row of denticles on the masticatory border, receptaculum seminis near to the mucus gland aperture, and penis unarmed without penial glands.

Cervera et al. (1987) described the most recent species of this genus, *Piseinotecus gaditanus* Cervera, García and García, 1987, from the southwest Iberian Peninsula. Externally, *P. gaditanus* is characterized by having six to seven groups of cerata on each side of the body. The cerata have a conspicuous white spot pattern and a deep reddish digestive gland is visible by transparency.

In addition to the Iberian Peninsula (Cervera et al., 1987; García-Gómez et al., 1991; Calado et al., 2005), *P. gaditanus* is currently known from the Canary Islands (Ortea et al., 2003), Cape Verde Archipelago (Ortea et al., 1993), and Senegal (Poddubetskaia in Trainito, 2005). However, images of specimens from French Atlantic coast assigned to this species are available on some websites (Barrabes, 2002; Köhler, 2003; Naslain, 2004; Poddubetskaia, 2006).

To date, *P. gaditanus* has been considered an easily identifiable species by its characteristic external anatomy and color pattern. However, recent detailed study of the internal anatomy of aeolid specimens collected from the Bay of Arcachon (France), eastern Atlantic, initially attributed to this species, have revealed that two very similar species are sympatric in this bay: *P. gaditanus* and another cryptic and undescribed species of the genus *Flabellina* Voigt, 1834 that we describe herein.

MATERIAL AND METHODS

The material examined in this study has been housed in the Muséum national d'Histoire naturelle of Paris (MNHN-Paris). The specimens, preserved in 98% ethanol, were dissected first by making a dorsal incision and examining the internal features using a dissecting microscope with a camera lucida. The buccal mass was dissolved in 10% sodium hydroxide until the radula was isolated from the surrounding tissue. The radula was then rinsed in water, dried, and mounted for examination by scanning electron microscopy (SEM). Special attention was paid to the morphology of the reproductive system.

SYSTEMATICS

Family Flabellinidae Bergh, 1889

Genus *Flabellina* Voigt, 1834

***Flabellina confusa* new species**

Material Examined.—Holotype: MNHN-Paris, one specimen dissected, 8 mm in length alive, 14 m depth, Hortense, Cap. Ferret, France (44°37'14.58"N, 01°14'37.50"W), 20 September 2006, M. Poddubetskaia. Other material: MNHN-Paris, one specimen dissected, 6 mm in length preserved, Hortense, Cap. Ferret, France, (44°37'14.58"N, 01°14'37.50"W), 23 September 2004, M. Poddubetskaia. MNHN-Paris, one specimen dissected, 7 mm in length alive, 3 m depth, Grand Piquey, Cap. Ferret, France, (44°42'52.82"N; 01°12'28.00"W), 26 September 2004, M. Poddubetskaia. MNHN-Paris, six specimens, five dissected, 4 mm in length preserved, Arcachon Basin, Cap Ferret, France, (44°37'45.41"N; 01°14'33.92"W), July–September 2005, M. Poddubetskaia. MNHN-Paris, eleven specimens, one dissected, 5 mm in length preserved, Arcachon Basin, France, (44°39'53"N; 01°10'2"W), June–July 2005, M. Poddubetskaia. MNHN-Paris, one specimen, 11 mm in length alive, 7 m depth, "St – Yves", Arcachon, France, (44°39'50.96"N; 01°10'26.65"W), 19 September 2006, M. Poddubetskaia. MNHN-Paris, one specimen, 11 mm in length alive, 12 m depth, Hortense, Cap. Ferret, France (44°37'14.58"N, 01°14'37.50"W), 20 September 2006, M. Poddubetskaia. MNHN-Paris, one specimen, 11 mm in length alive, 12 m depth, Hortense, Cap. Ferret, France (44°37'14.58"N, 01°14'37.50"W), 20 September 2006, M. Poddubetskaia. MNHN-Paris, one specimen, 10 mm in length alive, 8 m depth, "St – Yves", Arcachon, France, (44°39'50.96"N; 01°10'26.65"W), 8 August 2006, M. Poddubetskaia. MNHN-Paris, one specimen, 9 mm in length alive, 6 m depth, "St – Yves", Arcachon, France, (44°39'50.96"N; 01°10'26.65"W), 19 August 2006, M. Poddubetskaia.

Comparative material: *P. gaditanus*. Two specimens dissected, 6 and 8 mm in length preserved, Hortense, Cap. Ferret, France, (44°37'14.58"N, 01°14'37.50"W) 23 September 2004, M. Poddubetskaia.

Description.—The external morphology is identical to *P. gaditanus*. The body is elongate, slender, and the tail is long (Fig. 1A). Living animals are 7–11 mm in length. The anterior margin of the foot constitutes into two short and hooked propodial tentacles. The body color is hyaline white, although the ceratal surface is transparent which reveals the bright red branches of the digestive gland with translucent apex. This red coloration can darken to brown in the basal zone of the cerata. Moreover,



Figure 1. (A) *Flabellina confusa* n. sp.: living animal, holotype, photo by M. Poddubetskaia; (B) spawn of the *F. confusa* sp. nov.; (C) *Piseinotecus gaditanus* living animal, 9 mm in length (from Cervera et al., 1987).

the ceratal surface has conspicuous opaque white spots scattered all over it. Such spots protrude from the surface of the cera remarkably. Both sides of the head show a reddish spot that corresponds to the jaw plates that are visible through the body wall. The cerata emerge from stalks which are well elevated from the notum and are arranged in 5–7 groups. Each group contains 6–17 cerata. The number of cerata per group decreases from head to tail. The rhinophores are hyaline white, with opaque white apex. They are smooth, and longer than the oral tentacles. The oral tentacles are elongate and have the same color as the rhinophores, including an opaque white tip. The anus is located in an acleioproct position, and the nephroproct is anterior to the anus. The genital aperture is positioned below the first group of cerata on the right side of the animal.

Concerning the internal anatomy, the jaws (Fig. 2) have a masticatory border with three rows of numerous irregular, triangular denticles. The radula is triseriate, with a radular formula of $23-29 \times 1.1.1$ in 10 specimens measuring 7–11 mm alive and 4–6 mm preserved. The rachidian teeth (Figs. 3,A,C,D) are broad with a wide, triangular central cusp. They have 5–7 elongate, acute, and pointed denticles on either side of the cusp. The central cup of each rachidian tooth is depressed below the level of the adjacent denticles, in lateral view.

The narrow lateral teeth have a smooth inner edge (Figs. 3A–C). The number of denticles of the rachidian tooth increases from the older region of the radula to the younger. Some specimens have a small nick on the outer edge (Fig. 3A). The reproductive system has an androdiaulic arrangement (Fig. 4) and was examined in detail in 10 specimens of 7–11 mm. The narrow hermaphrodite duct widens into the rounded ampulla. The long postampullary duct bifurcates into the oviduct and vas deferens. The vas deferens widens into a glandular prostatic portion that is not very convoluted and opens in a wider proximal portion of the penial sac. The penis is short and unarmed. The receptaculum seminis is elongate and joins the oviduct in

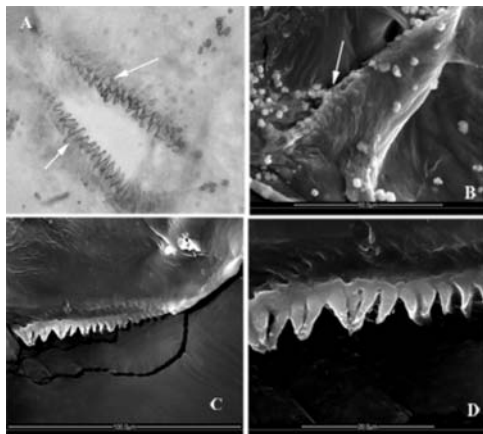


Figure 2. *Flabellina confusa* n. sp.: jaws. (A) light microscope of masticatory border of the jaws of the holotype (denticles pointed by arrows); (B) scanning electron micrographs of the masticatory border of the holotype (arrows point to denticles); (C) scanning electron micrographs of the masticatory border of one specimen from Cap Ferret (4 mm in length); (D) detail of the denticles of the masticatory border of the above specimen.

a proximal position. The oviduct continues for a short distance before entering the albumen gland.

Spawn.—Egg masses of *F. confusa* n. sp., were found on various species of hydroid (Fig. 1B), usually above hydroids of the genus *Eudendrium*. The spawn have an undulated ribbon shape, are thin, and have a length of about 3 mm. The spherical eggs are white and individually encapsulated.

Etymology.—The specific name refers to the early misidentification of specimens due to their extreme external morphological resemblance to *P. gaditanus*.

Distribution.—Thus far this species is known only from the Bay of Arcachon (France).

Discussion.—Cryptic species are species that are difficult or impossible to distinguish based on external morphological characters (Knowlton, 1993). Thus, defining species boundaries is the main problem raised by cryptic species, due to possible intraspecific polymorphisms. Nevertheless, in some cases, cryptic species can be distinguished by analysis of the internal anatomy. In accordance with the above, *F. confusa* n. sp. can be considered a cryptic species of *P. gaditanus*. In the Arcachon Bay area, both species are sympatric and live on the same species of hydroid of the genus *Eudendrium* Ehrenberg, 1834. However, the former has a triseriate radula while in *P. gaditanus*, the radula is uniseriate. Moreover, the masticatory border of *F. confusa* n. sp. is denticulated with three rows of denticles instead 1–2 rows in *P. gaditanus* (Cervera et al., 1987; Ortea et al., 1993). The reproductive systems of both species are very similar, but in *F. confusa* n. sp., the receptaculum seminis inserts on the oviduct in a more proximal position.

Calmella cavolini (Vérany, 1848) is another small aeolid resembling to *F. confusa* n. sp. and *P. gaditanus*, but endemic to the Mediterranean. It also has a triseriate radula very similar to that of *F. confusa*, but with a lower number of teeth. However, *C. cavolini* lacks the opaque white spots that are spread over the ceratal surface in *F. confusa* and *P. gaditanus*. Moreover, the cerata of the two anterior clusters are smaller in *C. cavolini* than in the other two species.

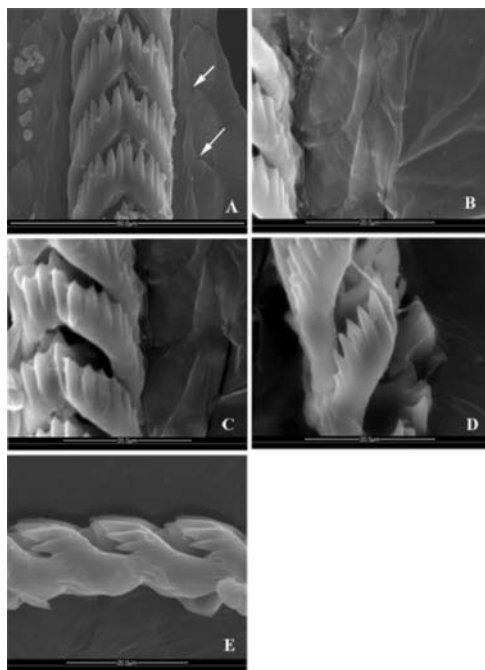


Figure 3. Radula. (A) *Flabellina confusa* n. sp., radular teeth of one specimen from Hortense, Cap. Ferret, (6 mm in length, preserved; arrows point to nicks on lateral tooth); (B) *F. confusa* n. sp., lateral teeth of the holotype; (C) *F. confusa* n. sp., rachidian teeth of the holotype; (D) *F. confusa* n. sp., lateral view of the rachidian tooth of one specimen from Hortense, Cap Ferret, (11 mm in length, live); (E) *Piseinotecus gaditanus*, rachidian teeth.

Current knowledge of examples of cryptic species of opisthobranchs in European waters is scarce. Nevertheless, some cases should be noted such as those of *Berthella aurantiaca* (Risso, 1818)/*Berthellina edwardsi* (Vayssi re, 1896) (see Cervera et al., 2006), *Dendronotus frondosus* (Ascanius, 1774)/*Dendronotus lacteus* (Thompson, 1840) (see Th llessen, 1998), *Doto coronata* (Gmelin, 1791)/*Doto sarsiae* Morrow, Thorpe and Picton, 1992 /*Doto hydrallmaniae* Morrow, Thorpe and Picton, 1992 (see Morrow et al., 1992), *Flabellina affinis* (Gmelin, 1791)/*Flabellina ischitana* Hirano and Thompson, 1990 (see Hirano and Thompson, 1990; Cervera et al., 1998; Gosliner, 2001; Garc a-G mez, 2002), *Geitodoris planata* (Alder and Hancock, 1846)/*Discodoris stellifera* (Vayssi re, 1904) (see Cervera et al., 1985, 2006), and *Hypselodoris cantabrica* Bouchet and Ortea, 1980/*Hypselodoris malacitana* Luque, 1986 (see Ortea et al., 1996; S nchez-Tocino, 2003). In all of these examples, the cryptic species

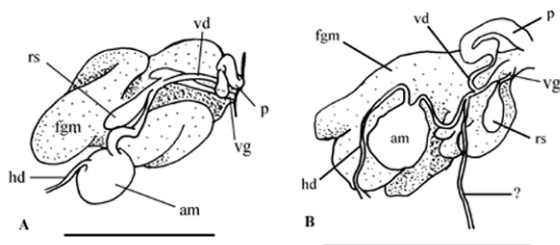


Figure 4. Reproductive anatomy, scale = 1.0 mm. (A) *Flabellina confusa* n. sp.; (B) *Piseinotecus gaditanus*. Abbreviations: am = ampulla, fgm = female gland mass, hd = hermaphroditic duct, p = penis, rs = receptaculum seminis, vd = vas deferens, vg = vagina.

belong to the same genus or, at least, to closely related genera and detailed observations of the external morphology can enable distinction or inference of different species. However, in the case of *F. confusa*/*P. gaditanus*, only the radula morphology distinguishes the species clearly. A recent but preliminary phylogenetic analysis places *Piseinotecus* together *Flabellina* and *Calmella* in the same clade (Gosliner et al., 2007). Nevertheless, additional analyses including more species and molecular data are needed to get more information before to may conclude that *Piseinotecidae* should be considered a junior synonym of *Flabellinidae*.

ACKNOWLEDGMENTS

This study has been partially supported by two Spanish Ministry of Education and Science grants, REN2001-1956-C17-02/GLO and CGL2006-05182, to J.L.C.

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DATE SUBMITTED: 10 May, 2007.

DATE ACCEPTED: 17 October, 2007.

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